TOTTENHAM HOTSPUR FOOTBALL CLUB

CONSTRUCTION COMPOUND NOISE IMPACT ASSESSMENT

Tottenham Hotspur Limited

SEPTEMBER 2015

WSP | PARSONS BRINCKERHOFF

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1 INTRODUCTION

1.1 PROJECT BRIEF

1.1.1 This report presents an assessment by WSP | Parsons Brinkerhoff (WSP | PB) of the noise associated with the use of The Goods Yard, 46-48 White Hart Lane, as a construction compound during the construction of the Northumberland Development Project (i.e. the proposed Tottenham Hotspur football stadium and associated development).

1.1.2 The compound is required for the siting of, in particular, a concrete batching plant, which will significantly reduce the amount of heavy vehicle movements on the road network associated with the Northumberland Development Project.

1.1.3 Haringey Council has requested that a noise assessment is submitted with the planning application for the compound.

1.2 ASSESSMENT SCOPE

1.2.1 Noise limits have been determined for key receptors, i.e. locations representative of the nearest dwellings to the site, based on guidance in the relevant British Standard, BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites* Part 1: *Noise*, and as presented in the 2015 Environmental Statement (ES) for the Northumberland Development Project.

1.2.2 Using the same Standard, together with details provided by the project team, the likely noise levels from the use of the compound have been determined at the key receptors. The comparison of these levels with the corresponding limits provides an indication of the likelihood of potential significant effects.

1.2.3 In addition to the assessment of the activities occurring on the site itself, consideration has been given to the noise effects associated with the use of the local roads by the vehicles associated with the operation of the compound, i.e. primarily the concrete mixers on route to and from the Northumberland Development Project site. This has been done by determining the likely change in existing road traffic noise levels, with the changes assessed against a standard significance scale relevant to road traffic noise.

1.2.4 No significant levels of vibration are anticipated from the proposed activities, nor was this raised by Haringey Council, and so vibration is not considered as part of the assessment.

1.2.5 This report is necessarily technical in nature, and, as such, a glossary of terminology is presented in Appendix A.

2 SITE DESCRIPTION AND NOISE-SENSITIVE RECEPTORS

2.1 SITE DESCRIPTION

2.1.1 The site of the proposed construction compound is shown in Figure B1 of Appendix B to this report. It is located at 46-48 White Hart Lane, approximately 0.5 km north-west of the Tottenham Hotspur stadium.

2.1.2 The site, which is located on the north side of White Hart Lane, is known as The Goods Yard, and is vacant. It is bounded to the west by the London Overground lines, and to the north and east by the corner of the Sainsbury's superstore and the western boundary of the Peacock Industrial Estate.

2.1.3 The southern-most part of the site, including the access off White Hart Lane, is narrow, but opens up to the widest point in the middle, before tapering down to a narrow point at the northern end, where the railway passes the superstore.

2.2 NOISE-SENSITIVE RECEPTORS

2.2.1 In the main, the noise-sensitive receptors are considered to be the nearest dwellings. The majority of which are separated from the site by either the railway lines and associated embankment, White Hart Lane, or the Industrial Estate. The exception to this is no.52 White Hart Lane, which is located to the west of the site access, and is understood to contain two or more residential flats. Furthermore, on the eastern side of the site access is the combination of The Grange Community Hub and Grange Day Care Centre. The Sainsbury's superstore is not considered to be noise-sensitive, especially since no windows overlook the site.

2.2.2 The next nearest dwellings are the flats in Charles House to the south of White Hart Lane, the houses in Pretoria Road to the west of the railway embankment, and the flats associated with the Rivers Apartments development, north of the Industrial Estate.

2.2.3 On this basis, the following key receptors have been adopted for the assessment:

- R1: The Grange Community Hub and Grange Day Centre (rear) – 2-2½ storey (M-F 8.30am to 5.15pm; Sat & Sun 9am to 3pm)
- R2: 52 White Hart Lane (rear) – 2 storey (flats)
- R3: Charles House, Love Lane – 10 storey
- R4: Pretoria Road Houses (south, nos.1-17) – 2 storey
- R5: Pretoria Road Houses (north, nos.35-45) – 2 storey
- R6: Rivers Apartments Tower Block – 23 storey

2.2.4 These receptors are also shown in Figure B1 within Appendix B.

2.2.5 In addition to these receptors, the receptors in proximity to the roads used by the vehicles accessing the site have also been considered. The assessment, however, as described below, is based on a notional distance of 10 m from the road, and it is not necessary to list any receptors specifically in this regard.

3 PROPOSED CONSTRUCTION ACTIVITIES

3.1 ON-SITE ACTIVITIES

3.1.1 An indicative layout of the site is shown in Figure B2 of Appendix B. It can be seen that the office and welfare facilities are to be located at the southern end, nearest White Hart Lane; a materials storage area is to be located in the middle of the site; and the concrete batching plant is to be located at the northern end of the site. An aggregate washing plant will be located in the vicinity of the batching plant, but which is not shown in the figure.

3.1.2 The key activities would be as follows:

- The operation of the concrete batching plant
- The operation of the aggregate washing plant
- Shovel loaders associated with the above
- Lorry movements associated with the above

3.1.3 There would be no parking on site, and no requirement for combustion plant power provision.

3.1.4 The details of the plant assumed for the assessment are presented in section 5 of this report.

3.2 OFF-SITE ACTIVITIES

3.2.1 The main role of the site would be the production of concrete for the main site. The concrete would be delivered to the main site via mixer trucks, whilst additional lorry movements will be required to supply the raw materials to the batching plant.

3.3 HOURS OF OPERATION

3.3.1 It is proposed to operate the site between 08:00 and 18:00 hours, seven days a week. This represents an extension of what would be considered normal or core operational hours for a construction site, of 08:00 to 18:00 hours Monday to Friday and 08:00 to 13:00 hours Saturdays. The hours beyond these core hours are described as ‘extended hours’ in this report.

3.3.2 No evening or night-time working is proposed.

3.4 MITIGATION MEASURES

3.4.1 Several legislative safeguards exist to minimise the effects of construction noise and would be applicable during the construction of the proposed development. These safeguards include:

- the various EC Directives and UK Statutory Instruments that limit the noise emissions of a variety of construction plant; and
- the powers that exist for local authorities under Sections 60 of the Control of Pollution Act 1974 and Section 80 of the Environmental Protection Act 1990 to control noise (and vibration) on construction sites and statutory nuisance respectively.

3.4.2 The Considerate Constructors Scheme, details of which can be found at the web page www.considerateconstructorsscheme.org.uk, is a scheme under which registered sites are monitored by an experienced industry professional to assess their performance against the eight point Code of Considerate Practice which includes the categories: ‘Considerate’, ‘Environment’,

'Cleanliness', 'Good Neighbour', 'Respectful', 'Safe', 'Responsible' and 'Accountable.' The main contractor will be required to register the site under this scheme.

3.4.3 Contract documents supplied to contractors will require that the effects of environmental noise are considered during the design and execution of the works. Such an assessment will require a noise control plan that provides a noise management system tailored to the specific needs of the construction works, the site and the surrounding area. As a minimum, any noise control plan will cover:

- procedures for ensuring compliance with statutory or other identified noise control limits;
- noise Action Levels (to be agreed with Haringey Council) above which consideration will be given to the use of alternative techniques and/or other means of reducing noise with the aim on ensuring that the Action Level (or below) is achieved. All practicable measures would be considered and implemented where appropriate together with additional consultation with the occupiers of potentially affected receptors;
- the review of the plant and mitigation measures, especially in response to breaches of the Action Level and/or complaints;
- procedures for ensuring that all works are carried out according to the principle of "Best Practicable Means" (BPM) as defined in the Control of Pollution Act 1974;
- general induction training for site operatives and specific training for staff having responsibility for particular aspects of controlling noise from the site;
- monitoring / auditing; and
- liaison with Haringey Council and the local business community.

3.4.4 The adoption of BPM is usually the most effective way of controlling noise from construction sites and will be enforced rigorously. In order to demonstrate the adoption of BPM to control noise emission from the site, the following conditions and measures would be imposed on the construction works:

- Local hoarding, screens or barriers will be erected as necessary to shield particularly noisy activities.
- Contractors will be required to bring to the site and employ on the works only the most environmentally acceptable and quietly operating plant and equipment compatible with the safe and efficient execution of the works.
- Noise emitted by any plant item will be required not to exceed the limits quoted in either the relevant EC Directive or UK Statutory Instrument and will be required to be no greater than the relevant values quoted in the current version of BS 5228.
- All plant items will be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise.
- All plant will be sited so that the noise impact at nearby noise sensitive properties is minimised.
- All items of plant operating on the site in intermittent use will be shut down in the periods between use.
- Care will be taken when loading and unloading vehicles to minimise noise.
- No radios or music will be permitted to be played on the site.

3.4.5 As stated earlier, there would be no parking on site, and no requirement for combustion plant power provision.

4 ASSESSMENT CRITERIA

4.1 ON-SITE ACTIVITIES

4.1.1 As stated earlier, the activities on the compound site may be undertaken over a seven day period. As such, assessment criteria have been derived for both the typical construction working days (i.e. 08:00 to 18:00 hours Monday to Friday and 08:00 to 13:00 hours on Saturdays) and for the possible extended hours of 13:00 to 18:00 hours on Saturdays and 08:00 to 18:00 hours on Sundays.

4.1.2 The criteria for the extended hours are 5 dB lower than those for the typical construction working periods, which were established in the 2015 ES. A shorter assessment period of one hour also applies.

4.1.3 All receptors identified above are considered to be of high sensitivity to noise, whereby the following scales apply equally.

Table 1: Impact Significance Scale for Construction Noise – Core Working Hours, Façade

NOISE LEVEL FROM CONSTRUCTION WORKS	SCALE OF IMPACT SIGNIFICANCE	SIGNIFICANCE OF NOISE EFFECT
<65 dB $L_{Aeq,T}$	Negligible	Likely to be insignificant
66 to 70 dB $L_{Aeq,T}$	Minor negative	
71 to 75 dB $L_{Aeq,T}$	Moderate negative	Potentially significant
>76 dB $L_{Aeq,T}$	Major negative	

Where 'T' = 10 hours (08:00 to 18:00) Monday to Friday, or 5 hours (08:00 to 13:00) Saturdays

Table 2: Impact Significance Scale for Construction Noise – Extended Working Hours, Façade

NOISE LEVEL FROM CONSTRUCTION WORKS	SCALE OF IMPACT SIGNIFICANCE	SIGNIFICANCE OF NOISE EFFECT
<60 dB $L_{Aeq,T}$	Negligible	Likely to be insignificant
61 to 65 dB $L_{Aeq,T}$	Minor negative	
66 to 70 dB $L_{Aeq,T}$	Moderate negative	Potentially significant
>71 dB $L_{Aeq,T}$	Major negative	

Where 'T' = 1 hour

4.2 OFF-SITE ACTIVITIES

4.2.1 It is considered sufficient and appropriate to assess the significance of the off-site vehicle movements in terms of the likely resultant change in overall road traffic noise levels at the nearest receptors.

4.2.2 Since the potentially affected receptors (in proximity to the roads that would be used by the vehicles accessing the compound site) are currently exposed to a certain level of transportation noise, it is the difference or change in noise level as a result of the operation of the construction compound that is important when assessing the significance of potential effects.

4.2.3 HD 213/11 *revision 1. Noise and Vibration* of the Design Manual for Roads and Bridges(DMRB) identifies that a change in road traffic noise of 1 dB $L_{A10,18h}$ in the short term (e.g. when a scheme is first operational) is the smallest that is considered perceptible. The scale used in the assessment of off-site construction vehicle movements is taken directly from HD 213/11, as presented below.

Table 3: Scale for the Assessment of Changes in Road Traffic Noise due to Construction Traffic

NOISE CHANGE	SCALE OF IMPACT SIGNIFICANCE	SIGNIFICANCE OF NOISE EFFECT
0.1 – 0.9	Negligible	Likely to be insignificant
1.0 – 2.9	Minor	
3.0 – 4.9	Moderate	Potentially significant
≥ 5.0	Major	

5 ON-SITE ACTIVITY ASSESSMENT

5.1 PREDICTED CONSTRUCTION NOISE LEVELS

5.1.1 The prediction of the likely noise levels during the operation of the compound have been undertaken in accordance with the procedures described in BS 5228-1:2009+A1:2014. Accordingly, the predictions are in terms of the $L_{Aeq,T}$ noise levels for the relevant operational periods.

5.1.2 Table 4 below sets out the approximate programme for the stadium site considering a seven day working week.

Table4: Approximate Programme of Construction Works

PHASE	PERIOD	DURATION (MONTHS)
Enabling Works	Jan 15 – Dec 15	12
Demolition (existing Stadium)	Jan 17 – June 17	6
Piling and Foundations	Sep 15 – Feb 16, May 17 – Jul 17	6, 3
Structure	Jan 16 – Oct 17	15
Roof Structure & Cladding	Mar 17 – Apr 18	14
Envelope	Jan 17 – Jun 18	18
Fit-out and Facilities	Sept 16 – Jun 18	22
Commissioning	May 18 – Jul 18	3

5.1.3 The expected plant and associated sound power levels assumed for the predictions are given in the table below along with the reference to the origin of this source information from Annexes C and D of BS 5228-1:2009+A1:2014 or WSP | PB measurements.

Table 5: Construction Plant Noise Levels

PLANT	DATA SOURCE	L_{WA} (dB) (EACH ITEM)	% ON-TIME PER DAY / 1-HOUR
Concrete Batching Plant	BS 5228 – D6.10	106	80 / 100
Aggregate Washing Plant	WSP | PB data[1]	107	80 / 100
Shovel Loaders x2	BS 5228 – C.6/32	103	20 / 60
Concrete Mixers[2] (idling)	BS 5228 – C.4/19	99	40 / 80
Lorry Movements	BS 5228 – C.2/34	108	N/A[3]

1 On Thursday 27th September 2015 WSP | PB undertook measurements of the aggregate washing plant operating on the Northumberland Project Development site. The level presented above represents the average of the measurements made at 10 m at several locations around the plant, corrected by +28 dB to determine the equivalent sound power level (L_{WA}).

2 The number of concrete mixers is accounted for in the percentage on-time.

3 The on-site lorry movements are predicted using the 'haul route' method given in BS 5228, which takes into account the predicted number of movements provided by the transport planner, and where the percentage on-time is not applicable. A worst case two-way hourly flow of 22 has been assumed.

5.1.4 For the purpose of these predictions, it is assumed that the intervening ground between the construction noise sources and the noise-sensitive properties will be acoustically hard such that there is no significant attenuation of sound due to ground absorption. Account is taken for any intervening screening, such as from the railway embankment and the proposed site hoarding.

5.1.5 All plant is assumed to be operating simultaneously (albeit subject to the percentage on-times presented in Table 5 above) as at the locations indicated on the site plan presented as Figure B2 of Appendix B. It is considered that the percentage on-times represent the likely worst case conditions.

5.1.6 Based on the activities and plant described above, the predicted noise levels are given in Table 6.

Table 6: Predicted Worst Case Construction Noise Levels – Façade $L_{Aeq,T}$, dB

RECEPTOR	PREDICTED NOISE LEVEL, dB $L_{Aeq,T}$[1] Core Hours[2]	Extended Hours[3]
R1: The Grange Community Hub and Grange Day Centre	52	53
R2: 52 White Hart Lane (rear)	54	55
R3: Charles House, Love Lane	55	59
R4: Pretoria Road Houses (south, nos.1-17)	53	54
R5: Pretoria Road Houses (north, nos.35-45)	57	59
R6: Rivers Apartments Tower Block	61	63

1 Where 'T' is 10 hours Monday to Friday, 5 hours Saturdays and 1 hour at all other times

2 08:00 to 18:00 hours Monday to Friday and 08:00 to 13:00 hours on Saturdays

3 13:00 to 18:00 hours on Saturdays and 08:00 to 18:00 hours on Sundays

5.2 SIGNIFICANCE OF PREDICTED CONSTRUCTION NOISE LEVELS

5.2.1 Based on the impact significance scales presented in Tables 1 and 2, the effect of the predicted construction noise levels are considered to be as shown in Table 7.

Table 7: Significance of Predicted Worst Case Construction Noise Levels

RECEPTOR	LIKELY SIGNIFICANCE OF IMPACT	
	Core Hours	Extended Hours
R1: The Grange Community Hub and Grange Day Centre	Negligible	Negligible
R2: 52 White Hart Lane (rear)	Negligible	Negligible
R3: Charles House, Love Lane	Negligible	Negligible
R4: Pretoria Road Houses (south, nos.1-17)	Negligible	Negligible
R5: Pretoria Road Houses (north, nos.35-45)	Negligible	Negligible
R6: Rivers Apartments Tower	Negligible	Minor

5.2.2 Accordingly, based on the assumptions and data presented in this report, no potentially significant effects are anticipated as a result of the on-site construction activities. This is considered to take into account the likely worst case noise levels from the site.

6 TRAFFIC NOISE ASSESSMENT

6.1 PREDICTED CHANGE IN ROAD TRAFFIC NOISE LEVELS

6.1.1 The Calculation of Road Traffic Noise (CRTN) memorandum published by the Department of Transport and Welsh Office in 1988 describes procedures for predicting (and measuring) noise from road traffic in terms of the L_{A10} parameter – the level exceeded for 10% of the time.

6.1.2 The CRTN sets out a step-by-step method for predicting road traffic noise levels in terms of L_{A10} for both a 1-hour period and an 18-hour period (between 06:00 hours and midnight) at any distance up to 300 metres from a highway. The prediction method takes into account the following factors to generate a Basic Noise Level (BNL) at a notional distance from the kerb (i.e. 10 m): traffic flow, mean speed, the percentage of heavy vehicles, along with the road surface and gradient. The procedures also enable the noise level at specific receptors to be determined by taking the BNL and applying corrections for distance, the presence of screening (barriers, buildings and topography), the type of intervening ground cover between the road and receiver, the angle of view of the road and reflections from façades.

6.1.3 In order to assess the significance of the additional noise generated by any vehicle movements associated with the operation of the construction compound, it is necessary to determine the expected change in road traffic noise levels. To this end, BNL predictions have been determined in accordance with the CRTN and based on traffic data supplied by Tim Spencer & Co, together with the following assumptions:

- → vehicle speeds are unchanged between the different scenarios;
- → 50 kph vehicle speed on all roads;
- → zero gradient on all roads for all scenarios; and
- → standard bituminous, impervious surface (e.g. hot rolled asphalt) on all roads for all scenarios.

6.1.4 One benefit of the compound site and the associated concrete batching plant is the reduction in vehicles on the wider road network delivering concrete to the main site. The vast majority of the vehicle movements associated with the compound site, therefore, will be between the compound site and the main site. The roads associate with this route will be limited to the A1010 (High Road) and White Hart Lane (between the A1010 and the compound site).

6.1.5 The baseline flows for these two road sections are shown Table 8 below. The flows are in terms of the 24 hour annual average daily traffic (AADT) flows. Since this period doesn't relate to either the periods covered by the CRTN procedures or those applicable to the compound site's hours of operation, it has been necessary to make the following assumptions:

→ As worst case, it is assumed that the 24 hour flows are equivalent to the 18 hour flows (06:00 to 00:00 hours). These are then divided by 18 to estimate the equivalent hourly flows for comparison with the hourly construction flows.

Table 8: Baseline Two Way Flows

ROAD/LINK	24 AADT BASELINE FLOW (%HGV)	18 HOUR BASELINE FLOW (%HGV)[1]	AVERAGE HOURLY BASELINE FLOW (%HGV)[2]	SPEED (KM/H)
The A1010 High Road (South of White Hart Lane)	17970 (7)	17970 (7)	998 (7)	50
White Hart Lane (west of the A1010 High Road)	12238 (4)	12238 (4)	680 (4)	50

1 Assumed to be the same as the 24 hour flow

2 Estimated by dividing the 24/18 hour flow by 18

6.1.6 As a further worst case scenario, to account for potentially quieter traffic flows that may occur during the extend Saturday and Sunday working periods, for example, flows 50% of the average hourly flows have also been considered below.

6.1.7 Based on the data provided by Tim Spencer & Co. the highest average hourly trip rate during the construction programme is predicted to be 11 (trips per hour, based on an 8.5 hour day), which are all assumed to be by lorry (i.e. HGV).

6.1.8 The predicted change in road traffic noise levels are shown in Table 9.

Table 9: Predicted Change in Road Traffic Noise Levels with Construction Traffic

ROAD/LINK	PREDICTED CHANGE IN HOURLY NOISE LEVEL	
	Based on Ave. Hourly Baseline Flows (see Table 8)	Based on 50% of Ave. Hourly Baseline Flows (see para. 6.1.6)
The A1010 High Road (South of White Hart Lane)	0.3	0.6
White Hart Lane (west of the A1010 High Road)	0.5	1.0

6.2 SIGNIFICANCE OF PREDICTED CHANGE IN ROAD TRAFFIC NOISE LEVELS

6.2.1 Based on the impact significance scales presented in Table 3, the effect of the predicted change in road traffic noise levels as a result of the construction traffic is considered to be as follows:

Table 10: Significance of Predicted Worst Case Change in Road Traffic Noise Levels

RECEPTOR	LIKELY SIGNIFICANCE OF IMPACT	
	Based on Ave. Hourly Baseline Flows	Based on 50% of Ave. Hourly Baseline Flows
The A1010 High Road (South of White Hart Lane)	Negligible	Negligible
White Hart Lane (west of the A1010 High Road)	Negligible	Minor

6.2.2 Accordingly, based on the assumptions and data presented in this report, no potentially significant effects are anticipated as a result of the construction traffic on either White Hart Lane or the A1010 High Road. This is considered to take into account the likely worst case construction traffic flows.

7 SUMMARY

7.1 ON-SITE ACTIVITY ASSESSMENT

7.1.1 An assessment has been undertaken to determine the likely noise levels at the nearest receptors during the use of the site known as The Goods Yard on White Hart Lane as a compound site for the Northumberland Development Project main site. The compound site would primarily be used for the production of concrete, whereby the main sources of noise would be a batching plant, aggregate washing plant and associated lorry/concrete mixer movements.

7.1.2 It is proposed to operate the site during normal and extended working hours, including Saturday afternoons and Sundays. Criteria for determining the likely significance of the predicted noise levels, taking into account the proposed hours of operation, have been adopted based on those presented in the ES for the Northumberland Development Project.

7.1.3 The predictions have been undertaken based on the guidance in the relevant British Standard (BS 5228-1), using a combination of the source data contained therein and that obtained by WSP | PB for the benefit of this assessment.

7.1.4 The noise-sensitive receptors have been identified as follows:

- R1: The Grange Community Hub and Grange Day Centre (M-F 8.30am to 5.15pm; Sat & Sun 9am to 3pm)
- R2: 52 White Hart Lane (flats)
- R3: Charles House, Love Lane (flats)
- R4: Nos.1-17 Pretoria Road (houses)
- R5: Nos.34-45 Pretoria Road (houses)
- R6: Rivers Apartments Tower (flats)

7.1.5 In the main, the impact of the predicted construction noise levels is considered to be negligible. The exception being at the Rivers Apartments Tower where a minor impact has been predicted during extended hours working, but which is still considered to be insignificant.

7.1.6 Given the worst case nature of the assessment, it is considered that the noise levels during the majority of the time will be lower than those shown in this report.

7.1.7 It is taken that the mitigation measures listed in section 3.4 of this report will be adopted in order to keep noise levels to a minimum.

7.2 TRAFFIC NOISE ASSESSMENT

7.2.1 In addition to the assessment of the site-based activities, an assessment has also been undertaken of the likely change in road traffic noise levels as a result of the operation of the compound site. This assessment, therefore, considers the potential effect on receptors along the haul route between the compound site and the main site, as opposed to the receptors identified above.

7.2.2 The route between the two sites comprises White Hart Lane and the A1010 (High Road) only, and baseline and construction flow data for which have been provided by the transport planner, Tim Spencer & Co.

7.2.3 The assessment has been undertaken using the prediction procedures given in the CRTN and the example significance scale in the DMRB. It has been found that no more than minor changes in road traffic noise levels are anticipated, which are not considered to be significant.

7.2.4 Overall, therefore, it is considered that the use of The Goods Yard site will not result in significant effects on the neighbouring noise-sensitive receptors or those in the vicinity of the haul route.

Appendix A

GLOSSARY OF TERMS

APPENDIX A-1

GLOSSARY OF TERMS

Noise is defined as unwanted sound. Human hearing is able to respond to sound in the frequency range 20Hz (deep bass) to 20,000Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used, which reduces the importance of lower and higher frequencies in a similar manner to human hearing.

The weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc, according to the parameter being measured. The Glossary explains the acoustic terminology that is used in this Report.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels found commonly in the environment is given in the table below.

Table A-1: Typical sound levels found in the environment

Sound Pressure Level, dB(A)	Location
0	Threshold of hearing
20 to 30	Quiet bedroom at night
30 to 40	Living room during the day
40 to 50	Typical office
50 to 60	Inside a car
60 to 70	Typical high street
70 to 90	Inside factory
100 to 110	Burglar alarm at 1m away
110 to 130	Jet aircraft on take off
140	Threshold of pain

The subjective response to a noise is dependent not only upon the sound pressure level and its frequency, but also its intermittency. Various indices have been developed to try and correlate annoyances with the noise level and its fluctuations.

- Sound Pressure: Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.

- Sound Pressure Level (Sound Level): The sound level is the sound pressure relative to a standard reference pressure of 20 Pa ($20x10^{-6}$ Pascals) on a decibel scale.

- Sound Power: The sound energy radiated per unit time by a sound source. Measured in Watts (W).

- Sound Power Level, L_W: Sound power measured on a decibel scale, relative to a reference value of 10-12 W.

- Decibel (dB): A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20 Pa.

- A-weighting, dB(A): The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.

- Noise Level Indices: Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.

- $L_{eq,T}$: A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.

- Free-Field: Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 m away.

- Façade: At a distance of 1 m in front of a large sound reflecting object such as a building façade.

Appendix B

FIGURES

FIGURE B-1: SITE & RECEPTOR LOCATION PLAN

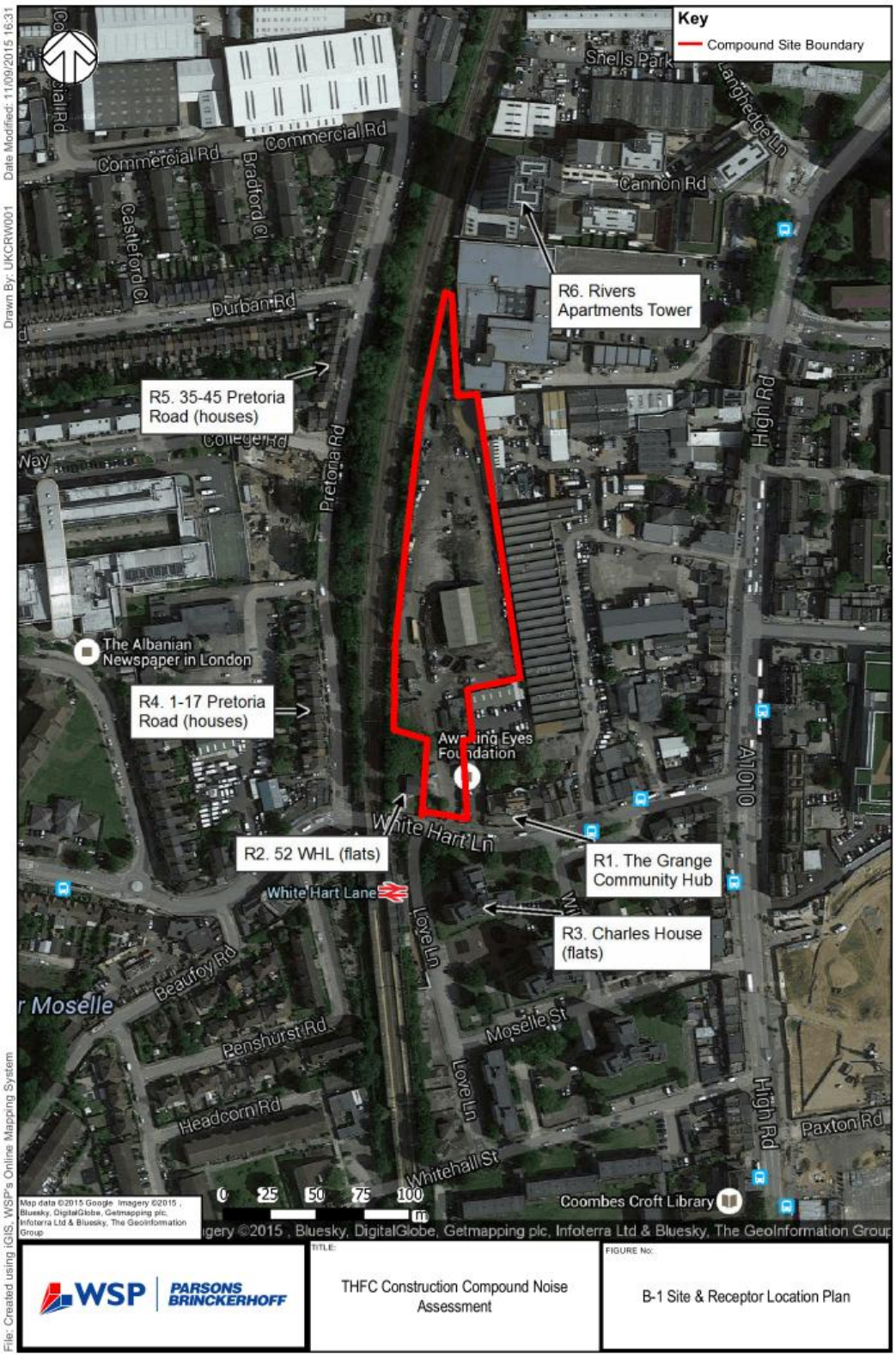
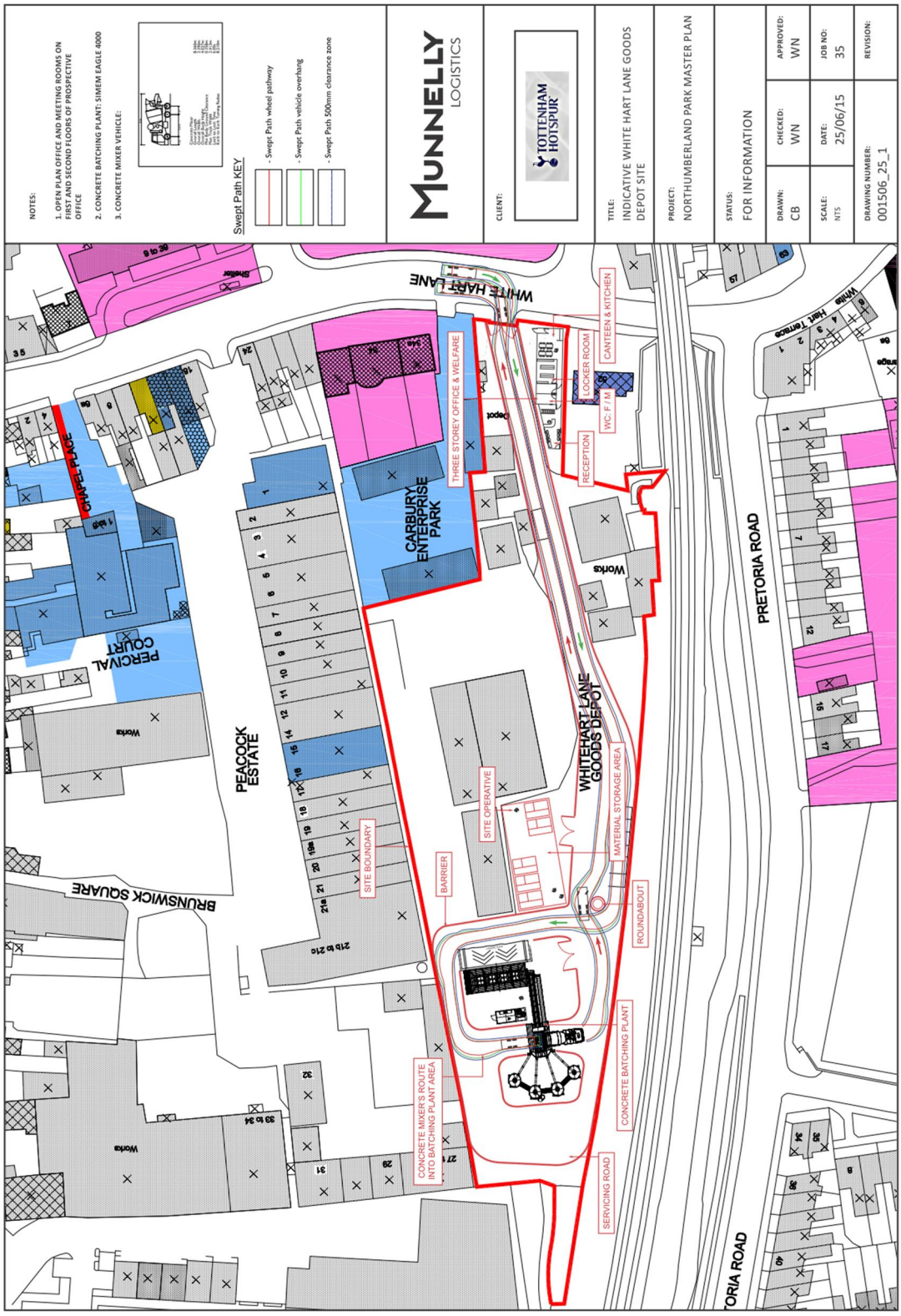
FIGURE B-2: INDICATIVE SITE LAYOUT PLAN